

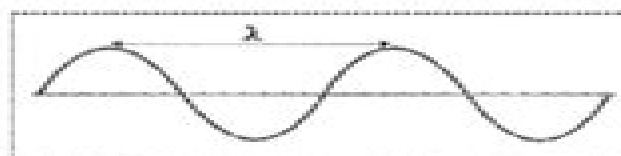


5: Flame Tests and Atomic Spectra (Experiment)

Objectives

- To perform flame tests of metal cations in order to observe their characteristic colors.
- To perform calculations to determine the frequency and energy of the emitted photons.
- To relate these results to the types of electronic transitions occurring in these elements.
- To observe and understand line emission spectra of atoms using gas-discharge tubes.
- To practice writing electron configurations for these (and other) elements.

Electromagnetic radiation is energy in the form of waves. Waves are characterized by their wavelength (λ) and frequency (ν). Wavelength is defined as the distance between successive crests (or troughs) on a wave, and is measured in meters. Frequency is defined as the number of waves that pass a given point every second, and is measured in 1/seconds ($1/s$ or s^{-1}), or Hertz (Hz).



All electromagnetic waves travel at the speed of light (c), or $3.0 \times 10^8 \text{ m/s}$. The relationship between the wavelength, frequency and speed of a wave is given by the equation:

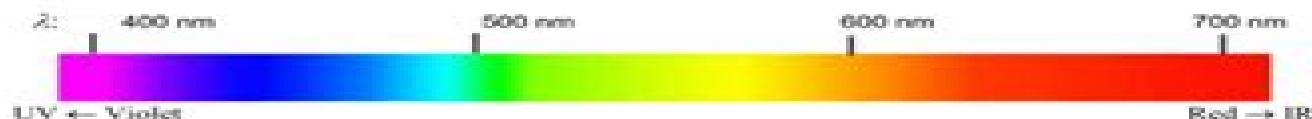
$$c = \lambda \times \nu \quad (5.1)$$

Electromagnetic radiation also occurs as discrete "packets" called photons. The energy (E) of a photon (in Joules, J) is given by the equation:

$$E_{\text{photon}} = h \times \nu \quad (5.2)$$

Here, h is Planck's constant, which has a value of $6.63 \times 10^{-34} \text{ J} \cdot \text{s}$.

Visible light is the most familiar example of electromagnetic radiation. Differences in the wavelengths of visible light are manifested as different colors, shown in the color spectrum below (colors can be seen in the PDF document on-line). Other examples of electromagnetic radiation include X-rays, ultraviolet light, infrared light, microwaves and radio waves.



So, how does electromagnetic radiation relate to flame tests? Well, when an atom or ion absorbs energy, its electrons can make transitions from lower energy levels to higher energy levels. The energy absorbed could be in the form of heat (as in flame tests), or electrical energy, or electromagnetic radiation. However, when electrons subsequently return from higher energy levels to lower energy levels, energy is released predominantly in the form of electromagnetic radiation.

The spacing between energy levels in an atom determines the sizes of the transitions that occur, and thus the energy and wavelengths of the collection of photons emitted.

Lab Manual Pavia Spectra

Thomas Griffiths



Lab Manual Pavia Spectra:

Undergraduate Instrumental Analysis, Sixth Edition James W. Robinson, Eileen M. Skelly Frame, George M. Frame II, 2004-12-02 Completely rewritten revised and updated this Sixth Edition reflects the latest technologies and applications in spectroscopy mass spectrometry and chromatography It illustrates practices and methods specific to each major chemical analytical technique while showcasing innovations and trends currently impacting the field Many of the chapters have been individually reviewed by teaching professors and include descriptions of the fundamental principles underlying each technique demonstrations of the instrumentation and new problem sets and suggested experiments appropriate to the topic About the authors JAMES W ROBINSON is Professor Emeritus of Chemistry Louisiana State University Baton Rouge A Fellow of the Royal Chemical Society he is the author of over 200 professional papers and book chapters and several books including Atomic Absorption Spectroscopy and Atomic Spectroscopy He was Executive Editor of Spectroscopy Letters and the Journal of Environmental Science and Health both titles Marcel Dekker Inc and the Handbook of Spectroscopy and the Practical Handbook of Spectroscopy both titles CRC Press He received the B Sc 1949 Ph D 1952 and D Sc 1978 degrees from the University of Birmingham England EILEEN M SKELLY FRAME recently was Clinical Assistant Professor and Visiting Research Professor Rensselaer Polytechnic Institute Troy New York Dr Skelly Frame has extensive practical experience in the use of instrumental analysis to characterize a wide variety of substances from biological samples and cosmetics to high temperature superconductors polymers metals and alloys Her industrial career includes supervisory roles at GE Corporate Research and Development Stauffer Chemical Corporate R D and the Research Triangle Institute She is a member of the American Chemical Society the Society for Applied Spectroscopy and the American Society for Testing and Materials Dr Skelly Frame received the B S degree in chemistry from Drexel University Philadelphia Pennsylvania and the Ph D in analytical chemistry from Louisiana State University Baton Rouge GEORGE M FRAME II is Scientific Director Chemical Biomonitoring Section of the Wadsworth Laboratory New York State Department of Health Albany He has a wide range of experience in the field and has worked at the GE Corporate R D Center Pfizer Central Research the U S Coast Guard R D Center the Maine Medical Center and the USAF Biomedical Sciences Corps He is an American Chemical Society member Dr Frame received the B A degree in chemistry from Harvard College Cambridge Massachusetts and the Ph D degree in analytical chemistry from Rutgers University New Brunswick New Jersey

The Forensic Laboratory Handbook Ashraf Mozayani, Carla Noziglia, 2007-11-08 A comprehensive and easy to read introduction to the work of the modern forensic laboratory The authors explain in simple language the capabilities and limitations of modern forensic laboratory procedures techniques analyses and interpretations Here the interested reader will find an understandable and fascinating introduction to the complex worlds of forensic serology DNA chemistry crime reconstruction digital evidence explosives arson fingerprints firearms tool marks odontology and pathology Additional chapters address the problems of assuring quality and seeking trace

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Kriz,Randall G. Engel,2005 Featuring 66 experiments detailing 29 techniques and including several explicating essays this lab manual covers basic lab techniques molecular modeling properties and reactions of organic compounds the identification of organic substances project based experiments and each step of the various techniques The authors teach at Western Washington University and North Seattle Community College Annotation 2004 Book News Inc Portland OR booknews com

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